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Financing Innovation in New Small Firms: New Evidence From Canada

by John R. Baldwin, Guy Gellatly and Valérie Gaudreault

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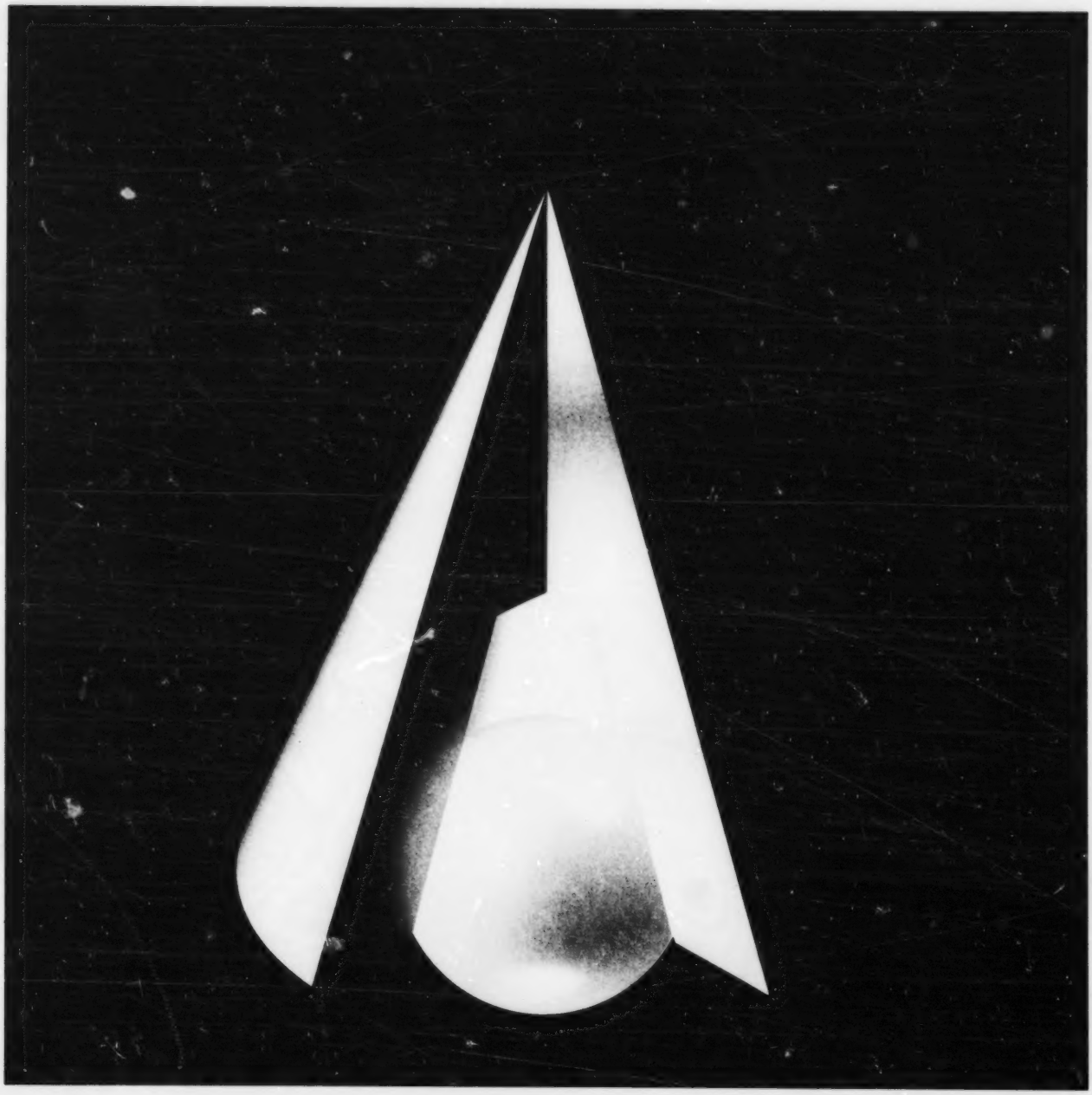

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Abstract

This paper investigates the financial characteristics of new small firms. The analysis develops a representative, small-firm financial profile, and evaluates the extent to which the proportionate use of different instruments and sources is correlated with industry-level and firm-specific characteristics. Multivariate methods are then used to examine relationships between financial structure, R&D-intensity and innovation.

Our results suggest that relationships between knowledge-intensity and capital structure are bi-directional. After controlling for a range of industry- and firm-level covariates, firms that devote a higher percentage of their investment expenditure to R&D also exhibit less debt-intensive structures. Conversely, debt-intensive structures also act to constrain investments in R&D. These relationships, however, depend upon the type of debt in the asset mix. It is the share of long-term debt to total assets that is negatively related to investments in knowledge.

Keywords: small-firm financing, innovation, research and development

Executive Summary

The challenge of financing small firms

Access to financing is seen to be a major challenge for small firms. Unlike large corporations, small firms are widely described as *constrained* by the operations of debt and equity markets. Yet access to debt and external equity is crucial if small firms are to support investments in new plant and equipment and in R&D.

Of ongoing interest is the extent to which financial constraints are more serious in debt than equity markets. A particular financing problem is said to exist for investments in R&D and new technology—investments that have been shown to bolster a firm's chances for growth and success. These investments are difficult to finance because they are risky and they offer less hard collateral to provide guarantees for loan financing.

If we are going to evaluate whether financial structure is a problem, we need to recognize that different types of funds bring with them different types of obligations. Firms that receive debt financing have fixed payments schedules and other restrictions that may constrain the activities that they can undertake. Because of this, they are less able to take risks associated with innovation if they borrow on debt markets.

Firms therefore face choices about the types of funds (equity versus debt) that they will seek and those that end up seeking one type of finance rather than another may well do so because they have different strategies in mind—some that are more risky than others.

This paper therefore asks three questions. First, what is the structure of the balance sheet of small firms in general and is there any indication that it is geared towards the more risky sources of funds? To answer this question, the paper includes a detailed analysis of types of financial instruments and funding sources used by small firms.

Second, it asks whether more successful small firms use different financial instruments and sources of funding than less successful firms. It also examines which factors—be they characteristics of a firm's industry environment, or aspects of a firm's performance history—are most likely to engender differences in small-firm balance sheets. This, in turn, yields new insights into whether capital markets are evaluating small businesses on their individual characteristics or on the characteristics of the markets in which they are located.

Third, the paper asks whether those firms that actually avail themselves of more debt financing succeed in producing more innovations. Much of the debate over small-firm financing assumes a link between the use of certain types of funds, such as long-term debt, and a firm's ability to support soft, intangible (yet potentially lucrative) investments like R&D. A final section of our analysis therefore attempts to learn whether firms with more access to debt capital are more advantaged than others—in terms of supporting R&D-based investment strategies and commercializing new products and processes.

Which group of small firms are being profiled – startups or older firms?

The analysis is based on an elite group of small businesses—entrants that have survived their first ten years of operation. Only 20 percent of new firms reach this milestone. These are firms that have survived because they were able to develop a core set of business skills. As mature entrants, they have had time to develop their financing strategies, arranging their financial assets to better support their business activities. It is worth emphasizing that these small firms operate across a large cross-section of goods and services industries, and not simply in high-tech hubs, such as computer services and telecommunications. This, in turn, affects the types of financing that one expects to observe. Venture capital funding is a case in point; venture capital accounts, on average, for less than 1% of all funding in the firms being examined here. Retained earnings and bank loans constitute the major sources of funding within these businesses.

Is there evidence that successful entrants are constrained in debt markets?

Small firms in our study use more equity than the corporate population as a whole. Equity accounts for almost one-half of total financing within this group, and 80% of this takes the form of retained earnings. By comparison, Canadian non-financial corporations reported that equity accounted for only 33% of their assets. Should the fact that small firms use less debt be taken as evidence that they are constrained in debt markets? Simply put, no. Small firms may have less debt-intensive financial structures either because they face greater difficulty obtaining debt or because many of these firms may simply prefer internal equity to debt financing for reasons of flexibility.

Where do differences in average capital structure emerge?

Are there specific industries in which equity is more likely to be used and debt is less likely to be used? Yes. Successful entrants that operate in knowledge-intensive environments rely less on debt financing, and more extensively on retained earnings, than their counterparts in less knowledge-intensive sectors. Once again, these differences may have more to do with the types of financing strategies that firms in a high-knowledge environment adopt in order to support their investment activities than with the alternative explanation that knowledge-intensive small firms face greater restrictions on debt.

Do certain financial profiles hamper investments in R&D and innovation?

One way of ascertaining whether the structure of the balance sheets of small firms, especially those in high-knowledge industries, is a result of conscious choice on the part of manager/owners rather than the restrictions imposed by financial markets is to ask whether firms that choose a debt strategy end up doing less innovation.

The extent to which certain financial structures should be viewed as "sub-optimal" depends upon whether these structures hamper the ability of small firms to grow and innovate.

We address this issue by examining relationships between financial structure, R&D and innovation. If debt-intensive small firms are more likely to engage in R&D and commercialize new products and processes, then issues of funding gaps in loan markets come to the fore. If, however, small firms prefer to support investments in knowledge with equity, as may be the case if equity affords firms greater flexibility, then the impact of alleged funding gaps in debt markets may be less severe.

Our results suggest that relationships between knowledge-intensity and capital structure run in both directions. After controlling for a range of industry-level and firm-specific factors, we find that small firms that devote a higher percentage of their investment expenditure to R&D also exhibit less debt-intensive structures. We also find some evidence that the presence of debt-intensive financial structures acts to constrain investments in R&D.

We conclude that shortages of equity (retained earnings and share capital) are more important impediments to innovative activity than imperfect debt markets.

1. Introduction

Firm-level research based on large, statistically representative survey databases has yielded new insights into the strategic foundations for growth and decline in the small-firm sector. Canadian research, utilizing a mixture of special business surveys and administrative databases, has produced detailed strategic characterizations of various performance-based subgroups within the small-firm population. Recent examples include Johnson, Baldwin and Hinchley (1997) and Baldwin et al. (1997), who found that the development of core functional competencies within the firm—basic skills related to marketing, management, production, financing and human resources—is often what serves to distinguish surviving entrants from failed ventures. New small firms that weather the vicissitudes of infancy emerge with a core set of business skills, many of which are underdeveloped in declining businesses. While external shocks are an important source of turnover within the small-firm sector, idiosyncratic deficiencies related to basic marketing and management skills also contribute significantly to the exit process. If the development of core competencies is a basic prerequisite for small-firm survival, it is specialized investments in knowledge creation, notably in research and development and technology acquisition, that serve as predictors of high-performance. Using an amalgam of firm-specific performance indicators (productivity, profitability and market share), Baldwin et al. (1994) demonstrated that more-successful SMEs are more likely to invest heavily in innovation programs.

One advantage of this survey-based research is that the analytical net can be cast widely—focusing on all elements of business strategy, from core business skills (e.g., marketing, management, production) to specialized innovation competencies (research and development and technology adoption). In this framework, financing is often treated as one of several strategic pillars that, along with other business competencies, help *define* the firm. This paper extends earlier research on small-firm financing by exploring relationships between capital structure and innovation. Financial inputs are unlike other inputs; they are ubiquitous, shaping all aspects of a firm's investment behaviour—its purchases of new machinery and equipment, its expenditure on workplace training, its advertising and marketing campaigns, and its research and development expenditures. Our analysis has two major objectives. First, we develop a comprehensive financial profile of new small firms, focusing both on their use of specific instruments and sources of funding. Our principal task at this stage is to ascertain whether the financial characteristics of these firms are correlated with different facets of their operating environment, or with firm-specific differences in investment activity, innovative stance and performance history. Second, we use multivariate techniques to investigate relationships between financial structure and innovative activity. Here we evaluate the extent to which differences in innovative stance affect the financial development of new small firms, and also whether the reverse is true—whether the financial characteristics of new small firms have any bearing on their innovative activity. This second issue is, in our view, the more illuminating, as it is tantamount to asking whether financial characteristics *matter*, that is, whether firms that develop, or that exhibit, certain financial profiles are more likely to pursue innovative activity than others.

We base our analysis on data collected from Statistics Canada's *Survey of Operating and Financing Practices (SOFP)*—a probability-weighted sample of roughly 3,000 small firms born between 1983 and 1986 that were still in operation in 1996. On analytical grounds, these data confer certain advantages. The database allows us to construct a representative profile of successful entrants, the 20% of new small firms that survive their first decade of operation (Baldwin et. al, 2000). These firms operate in a large cross-section of business sector industries, spanning both the goods and service sectors (see Johnson, Baldwin and Hinchley, 1997).

Our tabulations provide detailed insight into an important segment of the small firm population—successful entrants. By contrast, much of the empirical research on small-firm financing centres disproportionately on brand new startups, many of which, it is commonly held, face tightly binding constraints on external capital (typically in loan markets), and are thus forced to rely heavily on internal funds. As "mature entrants", the small firms in the SOPF sample have had time to "grow and adapt" their financial structures, adjusting their instrument mix and funding sources to better support their operating environment and investment activities. Following Moore (1994), small (high-technology) firms that have amassed market experience are less likely to face severe financing constraints than their younger counterparts.

The second advantage of the database rests with its comprehensiveness.

The analysis is as follows. We outline our conceptual framework in Section 2. Section 3 reviews the balance sheet of the average small firm within our surviving entrant sample. Section 4 motivates our subsequent analysis of the determinants of financial structure by reviewing major research themes on small-firm financing. Section 5 extends our analysis of small-firm balance sheets by exploring the variation in capital structure across a host of industry-level and firm-specific factors. Section 6 uses multivariate analysis to investigate relationships between financial structure and innovative activity.

2. Conceptual Framework

2.1 Operationalizing the Balance Sheet

The first part of this paper explores the balance sheet of surviving entrants, an elite subgroup within the small-firm population. Prior to any discussion of factors that can be expected to engender differences in financial characteristics within this group, we wish to draw attention to our treatment of the balance sheet itself. Many of our comparisons are based on the proportional use of different financial instruments and sources of funding. Financial instruments are classified into five major groups: retained earnings, share capital, short-term debt, long-term debt, and a residual group of other instruments.

Both forms of equity, retained earnings and share capital, are examples of relatively patient capital—flexible financial instruments that are not subject to the same rigid repayment or renegotiation conditions that are associated with debt capital, and pose no bankruptcy risk. Their flexibility, however, often comes at a high price; for many small firms, the cost of internal equity is related directly to the opportunity costs of personal funds, since the equity is derived from

loans on personal assets such as houses and real estate. Firms that turn to sources of external equity also incur substantial costs as investors typically demand a high rate of return over the long run.[1]

Table 1. A Taxonomy of Financial Structure – Instrument and Sources

Financing Instruments	Financing Sources
1. Retained Earnings (RE)	1. Internal Sources (IN)
	• Retained earnings
	• Owner managers
	• Employees
2. Share Capital (SC)	
	2. Financial Institutions (FI)
	• Banks and trust companies
3. Short-term Debt (SD)	3. Innovative Sources (IS)
• Short-term secured and unsecured debt	• Related firms
	• Joint ventures, strategic alliances
	• Venture capitalists, merchant banks, capital groups
4. Long-term Debt (LD)	• Silent partners
• Long-term secured and unsecured debt	• Public markets
5. Other (OT)	4. Other (OT)
• Trade credit	• Suppliers
• Convertible debentures	• Customers
• Contract financing	• Pension firms and insurance companies
• Investment tax credits	• Governments
• Grants	• Other
• Other	

On strategic grounds, the two equity instruments examined here—retained earnings and share capital—are quite dissimilar. Financing investment via retained earnings represents a *passive* financing strategy in that the firm is not required to seek and obtain capital, either from internal or external sources. As residual profits, however, retained earnings are volatile and cyclical (especially among small firms), and may not provide a stable flow of funding to long-term investments. In contrast, expanding the ownership structure of the firm via share issue, whether accomplished through inward-looking strategies (owner/managers) or outward-looking strategies (angels, venture capitalists), represents an *active* financing strategy, one more open to external evaluation and control.

[1] Caldwell, Sawchuk and Wilson (1994) found that small firms in Canada face comparatively high external equity costs.

The next major type of financing examined here is external debt (secured and unsecured loans). Debt-financing often places more constraints on the firm than equity financing.[2] It typically entails fixed repayment schedules, which, if missed, bring about serious financial repercussions for the firm. In what follows, we decompose debt holdings into short-term and long-term components. Following Hughes (1993), financial institutions may exhibit a clear preference for short-term lending in their dealings with small firms. Short-term contracts *"allow banks the freedom to roll over the funding when things are going well, but to extricate themselves relatively quickly when things are going badly. This may be especially attractive in relation to the small firm sector, which is relatively volatile and risky. It also reduces the need to develop industry or firm specific knowledge on which to base longer-run or more interventionist strategies"* (p. 219).

Our final group is comprised of a diverse mixture of instruments, many of which, on aggregate, comprise only minor additions to the balance sheet. An exception is trade credit, a more significant form of financing within our small firm population. Trade credit can be considered a form of short-term debt, but is here left to our residual category. Other examples of financing instruments that we classify to this residual group include contract-financing, convertible debentures, investment tax credits and government grants, as well as miscellaneous financing.

We next decompose the balance sheet based on the different sources of funding that firms draw on when financing their investment activities. Here our aggregate groupings closely parallel those of Baldwin and Johnson (1996). Four groups of sources are examined: internal sources, financial institutions, innovative sources (e.g., venture capital and public markets), and a residual group (Table 1). Our intent here is to distinguish, first, between internal and external funds, and second, in the case of external sources, between traditional debt markets and specialized financial intermediaries. This distinction is made because research on funding gaps (of the sort often attributed to credit rationing and/or price discrimination in loan markets) has focused on the wedge between the costs of internal and external finance. What is more, many studies of high-technology small firms and knowledge-based industries have emphasized the emerging role of specialized financial intermediaries, such as venture capitalists or equity investors, in overcoming funding shortfalls in traditional loan markets. Most of the individual sources examined herein constitute formal sources of capital, that is, funds that flow from creditors to firms based on the operation of formal markets. Of the five types of innovative sources—related firms, joint ventures, venture capitalists, public markets, and silent partners—only silent partners (e.g., family investors) can be considered informal in that funding decisions are more idiosyncratic in nature. Other examples of less formal, more idiosyncratic sources of capital include owner/managers and employees (sources that we classify as internal to the firm) and customers.

[2] This distinction is straightforward when comparing debt-financing to internal sources of equity such as retained earnings; as we report below, retained earnings, on balance, represent the vast majority of equity holdings in small firms. The notion that debt-financing strategies impose higher constraints on the firm is admittedly less straightforward when comparisons are made directly with other forms of external equity, such as venture capital financing, access to which is often conditional on the firm making a host of ownership and monitoring concessions. For a useful overview of venture capital financing, see Zider (1998).

2.2 Summary Measures of Financial Structure

In the second part of this paper, our objectives become more ambitious, as we attempt to disentangle, via multivariate regressions, relationships between capital structure and innovative activity. This requires a more parsimonious operational treatment of financial structure. To this end, we first adopt a basic indicator of debt intensity—the share of the capital mix accounted for by long-term debt[3]. We then complement this debt ratio with a set of financial characteristics derived from principal component analysis; this, in turn, enables us to explore basic differences in financing strategies within the small-firm population.

We select a long-term debt ratio, first, because standard accounting techniques rely on long-term debt ratios as a proxy for risk, and second, in light of orthodox views of financial management in which firms within a given industry environment work towards some targeted debt-to-equity optimum. Building on the short versus long-term distinction outlined by Hughes (1993), long-term debt ratios also provide some indication of the extent to which firms are able to acquire low-cost, semi-permanent forms of capital from traditional lending institutions, of the sort that requires, to a much greater extent than short term contracts, stable ongoing relationships.

Their computational and conceptual appeal aside, financial ratios are not without their limitations. First, debt ratios are not unambiguous signals of how risk affects the asset structure, as evidenced solely by the firm's access to, or utilization of, debt. High-risk firms can be expected to have less access to debt, and, in turn, rely more extensively on residual profits, bringing about, other things equal, a lower debt-equity ratio. Conversely, low-risk firms should have greater access to loans and exhibit concomitantly higher gearing or leverage ratios. This said, debt ratios are also influenced by performance, that is, the firm's ability to generate equity. High-performance firms may generate more retained earnings, which reduces their debt-to-equity ratio via an expansion of the capital mix. For this reason, when evaluating financial ratios, high-performance firms may look very similar to high-risk firms. Conversely, less-successful firms may exhibit high debt-to-equity ratios, not because they have greater access to debt (as we would expect of low-risk firms), but because they generate less equity.

Second, debt-ratios may not be stable over time if investments schedules are "lumpy", that is, if large debt-financed expenditures occur discontinuously and represent a substantial share of the firm's asset mix. Small firms have more modest holdings, and may fluctuate between equity-intensive and debt-intensive structures due to the financial impact of large one-time investments. Lastly, cross-sections of the small-firm population may obscure (or exacerbate) differences in debt-intensity if lending patterns are highly sensitive to the business cycle. Simply put, there may be more slack in loan markets in expansionary times than in recessionary times, which, in turn, may influence how certain characteristics engender differences in capital structure. Firms that pursue high-risk activities are apt to be less risky in good times than in lean times, and acquire more debt.

[3] We define this as item 3 (long term secured and unsecured debt) in the instrument ledger in Table 1, expressed as a ratio of total financing.

We raise these issues with a simple caveat in mind: one must tread cautiously when evaluating differences in financial ratios. Of the three issues raised above, the first is the most serious, as differences in debt-intensity owing to performance differentials bear little relation, on conceptual grounds, to explanations rooted in risk; firms that look to be a "good bet" in the sense that they exhibit high gearing ratios may mask, within their ranks, many underachievers. Issues two and three raised above are less severe, in that they pertain more to matters of intertemporal stability. At root here are questions about whether debt-to-equity profiles, if ephemeral, constitute useful summary indicators. Even if debt ratios do fluctuate rapidly in accordance with investment expenditures or macroeconomic cycles, on average, they still provide a legitimate snapshot of financial characteristics at any one point in time.

We address these concerns via comparative methods—evaluating the robustness of our regression results using different operational definitions of capital structure and by including measures of performance and risk. While this does not alleviate our dependency on debt-ratios, it does provide some evidence for whether the reported results are contingent upon our particular definition of capital structure. We also test the robustness of our results by using alternate measures of capital structure. We supplement our ratio-based measures by focusing on strategic profiles—key combinations of financial instruments and funding sources represented by principal component variables. This enriches the issue under investigation; instead of asking whether firms with more debt (or more equity) are more innovative, we can also ask whether the likelihood of innovation is linked to basic financial profiles, such as firms that trade off debt from traditional sources of capital against share capital and funding from innovative sources.

Prior to undertaking any comparative analysis of small-firm financing, we first require a more general understanding of the financial characteristics that, on balance, serve to characterize the surviving entrant population. We turn to this below.

3. The Balance Sheet of Surviving Entrants

3.1 Use of Various Financing Instruments

The average financial structure—the proportional representation of different financial instruments within the capital mix—is reviewed below. [4]

Almost half of new firms' financing (47%) is equity financing. Retained earnings are the single most important type of financing for small firms, representing, on average, nearly 40% of the capital structure. Long-term and short-term debt account for 19% and 16% of the average capital mix, respectively. Secured debt represents the lion's share of each. Of the other financing instruments, only trade credit is present in significant amounts, comprising 11% of capital structure.

[4] Share values are firm-weighted, and thus represent estimates of the true population means.

Differences in capital structure associated with firm size are not apparent. Equity and debt shares are extremely consistent across the three size ranges profiled herein. It should be stressed that our firm-size categories are narrowly defined, and may not capture the sort of variation in scale or scope economies that can be expected to engender concomitant differences in capital structure; the majority of firms in our sample are still very small when they reach early adolescence.[5]

The importance of equity capital within the surviving entrant population mirrors the results of earlier research on Canadian firms. Baldwin et al. (1994) found that, among growing SMEs, equity made up about 36% of total capital. This is slightly lower than the levels reported here, but the firms in this earlier sample were, on average, larger and more mature. Long-term debt accounted for about 18% of total capital within the growing SME population and short-term debt for about 15%. Similar to our results for surviving entrants, firms within the growing SME sample also placed similar weight on equity financing, irrespective of firm size. However, among growing SMEs, the share of total equity derived from retained earnings declines while the share from paid-in-capital increases in larger as opposed to smaller firms.

Table 2. Percentage distribution of financing instruments (firm-weighted)

	All Firms	1-9 Employees	10-24 Employees	25+ Employees
Equity Capital				
Retained earnings	38.8	38.8	38.6	39.0
	(2.4)	(3.1)	(3.7)	(5.1)
Share capital	7.8	8.1	6.1	8.1
	(1.1)	(1.4)	(1.2)	(2.3)
Long-term Debt				
Secured	16.0	15.0	18.9	19.2
	(1.7)	(2.0)	(3.7)	(3.8)
Unsecured	3.2	3.9	1.2	1.5
	(1.0)	(1.3)	(0.4)	(0.5)
Short-term Debt				
Secured	11.6	11.4	14.0	9.8
	(1.6)	(2.1)	(2.9)	(2.0)
Unsecured	4.4	4.4	5.5	2.8
	(1.4)	(1.8)	(2.7)	(0.8)
Other Instruments				
Trade Credit	10.8	10.9	8.1	14.5
	(1.7)	(2.3)	(1.7)	(2.3)
Convertible debentures	0.2	0.2	0.0	0.1
	(0.1)	(0.2)	(0.0)	(0.1)
Contract financing	2.4	2.8	1.5	1.3
	(1.2)	(1.6)	(0.6)	(0.5)
Investment tax credits	0.3	0.2	0.5	0.5
	(0.1)	(0.1)	(0.2)	(0.2)
Grants	0.2	0.2	0.2	0.7
	(0.1)	(0.1)	(0.1)	(0.6)
Miscellaneous	4.2	4.2	5.5	2.3
	(1.5)	(1.9)	(3.5)	(0.6)

* Percentages may not sum to 100 because of rounding. Standard errors are in parentheses.

[5] Seventy-five percent of firms in the surviving entrant population operate with fewer than 10 employees.

It should be noted that both these groups—small surviving entrants and growing SMEs—use equity capital to a greater extent than the average firm in the corporate universe. Over the period 1992-96, Canadian non-financial corporations reported that their equity accounted for only 33% of their assets.[6] New young firms rely far more on equity to fund their operations than the corporate population as a whole. More illuminating, retained earnings makes up only about one-half of total equity in the corporate population, whereas it accounts for over 80% of equity in surviving entrants. Among growing SMEs, firms with less than 5 employees report that paid-in-capital accounted for only 13% of total equity on average, but this increased to around 40% for firms with 10-25 employees.

The reliance of firms on different financing instruments is examined in Table 3.

Table 3. Reliance on various types of financing (firm-weighted)

	All Firms	1-9 Employees	10-24 Employees	25+ Employees
Percentage of firms relying on a single-source of financing:	**49.1 (3.3)**	**53.9 (4.1)**	**35.3 (5.6)**	**34.8 (6.0)**
Equity capital	26.9 (2.6)	29.3 (3.4)	19.7 (3.2)	19.7 (5.8)
Long-term debt	7.4 (1.3)	7.3 (1.6)	7.5 (3.3)	8.5 (3.6)
Short-term debt	6.2 (1.8)	7.3 (2.4)	3.1 (1.1)	2.9 (1.1)
Other instruments	8.5 (2.3)	10.0 (3.0)	5.0 (3.5)	3.7 (1.2)
Percentage of firms relying on multiple types of financing:	**50.8 (3.3)**	**46.1 (4.1)**	**64.6 (5.6)**	**65.2 (6.0)**
Equity and any other instrument(s)	45.6 (3.2)	40.7 (3.9)	59.6 (5.9)	60 (6.0)
Short and long-term debt only	2.5 (0.9)	2.6 (1.0)	3.1 (1.4)	1.1 (0.2)
Debt instruments and other non-equity instruments	2.8 (1.3)	2.8 (1.7)	2.0 (0.7)	4.1 (2.6)

* Percentages may not sum to 100 because of rounding. Standard errors are in parentheses.

Almost half of all firms (49%) depend on only one type of capital (Table 3). Among these firms, equity instruments are the most commonly used (27% of surviving firms), followed by 9% firms that rely on other instruments (the vast majority of which is trade credit). Seven percent of new small firms rely strictly on long-term debt, and 6% on short-term debt. The remaining half of the surviving entrant population maintains more complex capital structures, drawing on a mix of instrument types. Among these firms, many rely on some form of equity in combination with another instrument type—46% of firms combine equity with some other instrument(s) (short-term debt, long-term debt, or other instruments). Only 6% of firms combine different instrument groups without any equity representation.

[6] *Financial and taxation statistics for Enterprises, 1996*, Catalogue No. 61-219. Ottawa: Statistics Canada. p. 32

When viewed in this light, size-based differences in capital structure become more apparent. More than one-half of the smallest firms (54%) rely on one type of financing instrument, compared to about one-third of firms in the larger size groupings.[7] Smaller firms have less diversity than larger firms and are therefore more dependent on a single source. They are also less likely to be able to efficiently match their financing to particular activities, unless their activities are also less complex. Within the surviving entrant population, 29% of small firms rely strictly on equity, compared to 20% firms in the larger size classes.[8]

3.2 Sources of Financing

We next examine the balance sheet from an alternative perspective—by focusing on the proportional use of different funding sources (Table 4).

Table 4. Percentage distribution of financing sources (firm-weighted)

	All firms	1-9 employees	10-24 employees	25+ employees
Internal sources				
Retained earnings	38.8	38.9	38.6	37.8
	(2.4)	(3.1)	(3.8)	(5.3)
Owner managers	12.3	13.3	7.6	11.9
	(1.5)	(1.9)	(1.1)	(2.6)
Employees	0.3	0.4	0.1	0.1
	(0.3)	(0.3)	(0.1)	(0.0)
Financial institutions				
Banks and trust companies	33.6	32.9	39.9	29.3
	(2.6)	(3.3)	(4.8)	(3.9)
Innovative sources				
Related firms	1.7	0.8	4.9	4.1
	(0.6)	(0.3)	(3.5)	(2.3)
Joint ventures, strategic alliances	0.7	0.9	0.0	0.2
	(0.4)	(0.6)	(0.0)	(0.2)
Venture capitalists, merchant banks, capital groups	0.4	0.4	0.1	0.8
	(0.2)	(0.2)	(0.0)	(0.4)
Silent partners	0.6	0.7	0.5	0.4
	(0.2)	(0.3)	(0.2)	(0.1)
Public markets	0.3	0.3	0.2	0.5
	(0.1)	(0.1)	(0.1)	(0.1)
Other sources				
Suppliers	6.8	6.6	6.0	10.2
	(1.1)	(1.5)	(1.3)	(1.9)
Customers	0.7	0.8	0.9	1.3
	(0.2)	(0.3)	(0.3)	(0.5)
Pension firms and insurance companies	0.0	0.0	0.1	0.0
	(0.0)	(0.0)	(0.1)	(0.0)
Governments	1.3	1.4	0.4	1.9
	(0.5)	(0.7)	(0.1)	(0.8)
Other	2.4	2.9	0.5	1.3
	(1.2)	(1.6)	(0.2)	(0.4)

* Percentages may not sum to 100 due to rounding. Standard errors are in parentheses.

[7]Differences in instrument-based specialization rates between firms in the small size class and those in other size groupings are statistically significant at the 1% level of confidence.

[8] Differences are significant at the 5% level of confidence.

Capital market limitations on new small firms suggest that surviving entrants will rely more extensively on internal sources of funds. Just over one-half of all firms in our study rely solely on internal sources—39% on retained earnings and 12% on capital from owners and managers. The bulk of remaining funds (34%) is supplied by banks and trust companies. Innovative sources of funds—(eg.) related firms, venture capitalists, public markets—account for very little (4%) of the funding mix. The only other significant source of funding is suppliers, which comprise 7% of the average source mix. There is no simple relationship across size classes in the percentage of funds that are provided by various sources.

We can again compare these results to earlier research on Canadian firms. Among growing SMEs, Baldwin et al. (1994) report that about 35% of total funds were derived from retained earnings and individuals—substantially less than firms in our sample. Larger growing SMEs relied less on profits as a source of funds and more on affiliates. Growing SMEs also look to suppliers to a greater extent than do surviving entrants.

The mix of various funding sources within the capital structure is examined in Table 5.

Table 5. Reliance on various sources of financing (firm-weighted)

	All firms	1-9 employees	10-24 employees	25+ employees
Percentage of firms relying on a single group of sources for financing:	**49.8** (3.2)	**53.7** (4.0)	**38.5** (5.8)	**37.9** (6.0)
Internal source	28.1 (2.6)	30.6 (3.4)	20.7 (3.3)	21.1 (5.9)
Financial institutions	16.2 (2.5)	17.3 (3.1)	13.4 (3.6)	12.5 (3.6)
Innovative sources	2.0 (0.7)	1.5 (0.6)	3.9 (3.4)	2.9 (2.3)
Other sources	3.3 (1.4)	4.2 (1.8)	0.5 (0.2)	1.5 (0.5)
Percentage of firms relying on multiple groups of financing sources:	**50.2** (3.2)	**46.3** (4.0)	**61.5** (5.8)	**62.1** (6.0)
Internal and financial institutions	18.9 (2.5)	15.9 (2.7)	33.1 (7.2)	19.5 (4.5)
Internal and other sources	9.2 (2.0)	9.4 (2.6)	8.4 (3.0)	9.4 (3.5)
Internal, financial institutions and other	13.3 (2.4)	13.0 (3.1)	10.9 (2.5)	19.0 (4.1)
All other combinations	8.8 (1.8)	8.1 (2.3)	9.1 (2.1)	14.2 (3.4)

* Percentages may not sum to 100 due to rounding. Standard errors are in parentheses.

One-half rely on more than one source of funding. Combinations that include internal funds and bank debt are the most common. Thirteen percent of firms combine internal funds and bank debt with capital from our residual group of other sources.

Differences again emerge when we compare how firms of different sizes diversify across different sources of funds. Smaller firms are much more likely to depend on a single source (54%) than firms in the medium and larger size classes (39% and 38%, respectively).[9]

3.3 Diversification in the Instrument and Source Mix

In the main, new small firms rely on a significant amount of equity capital. However, there is also a strong tendency for individual firms to rely on a small number of financing instruments and funding sources. This dependence on individual sources of financing makes new firms, particularly smaller ones, susceptible to the volatility of individual financial markets since they do not diversify as much as larger firms. Their degree of specialization also makes it more difficult to match investments to particular sources of funds. One additional method of evaluating this dependence is to examine the numbers equivalent entropy associated with the instrument and source mix. This numbers-equivalent measure is derived from an entropy-based metric of diversification in which

$$(1) \qquad Entropy = \sum_{i=1}^{N} s_i \log(1/s_i)$$

where s_i is the share value associated with a particular instrument or source.[10] The antilog of this index provides a statistical measure of *how* diversified the instrument or source mix actually is. Entropy is calculated across all 12 financing instruments and 14 funding sources, respectively. For example, a numbers equivalent value of 2.0 indicates that, on average, a firm is about as diversified as one that allocates its capital structure equally across two instruments. Number equivalent measures provide considerable insight into the extent to which firms are relying on a small number of instruments or sources. We report entropy statistics below in Table 6.

Table 6. Numbers-equivalent entropy (firm-weighted)

	All Firms	1-9 Employees	10-24 Employees	25+ Employees
Average NE entropy (instruments)	1.8	1.7	2.0	2.2
	(0.1)	(0.1)	(0.1)	(0.1)
Average NE entropy (sources)	1.7	1.6	1.8	2.0
	(0.1)	(0.1)	(0.1)	(0.1)

Standard errors are in parentheses.

[9] Differences between small firms and those in other size ranges are statistically significant at the 1% level of confidence.

[10] For an example of the use of this measure, see Jacquemin and Berry (1979).

These statistics confirm that the average capital mix, whether evaluated in terms of instruments or sources, is highly specialized. Among the surviving entrant population, the numbers-equivalent entropy score is 1.79 when evaluated in terms of instruments and 1.71 when evaluated in terms of sources. There is a tendency for firms to become slightly more diversified with increased size, as both instrument- and source-based entropy scores increase monotonically across our size ranges.[11] Even among the larger firms, however, capital structures are still heavily skewed towards small numbers of instruments or sources.

4. Research on Capital Structure

The previous section has shown (1) that small firms tend to rely more extensively on equity than on debt, and (2) tend to be highly dependent on a small number of financing instruments and funding sources. There are many other factors, aside from firm-size, that can be expected to engender differences in capital structure. Prior to examining these factors, we need to set our analysis in context. In what follows, we review some of the research themes that, taken together, motivate applied work on small-firm financing.

Research on financial structure has traditionally focused on two related themes: (1) external financing constraints (supply-side factors that affect the price at which different types of external capital—debt and equity—are made available to businesses) and (2) owner/manager financing preferences (demand-side factors that identify the extent to which the firm is *willing* to acquire and hold different types of capital within its asset mix). Supply-side constraints on external financing are generally attributed to problems of adverse selection, moral hazard and high verification costs. All stem from information asymmetries that are posited to raise the cost of external capital relative to internally-generated funds (Berger and Udell, 1998). These information asymmetries can be particularly acute when evaluating new small firms, as many lack a proven track record that can serve as performance (or competency) signals to prospective creditors. As a result, lenders and investors often do not possess reliable information on the prospective competencies of firms that enable them *ex ante* to distinguish between more- and less-risky ventures.

Much of the debate over funding gaps centres on the supply-side issues outlined above—on how firms with certain (high-risk) operating characteristics are evaluated by external capital markets, either in traditional loan markets, or in specialized equity markets (e.g., markets for angel and venture capital). Differences in risk can be expected to engender concomitant variations in capital structures. While seemingly uncontroversial, base assumptions regarding the relationship between risk and capital structure need to be made explicit. External creditors base lending decisions on the likelihood that a firm will be in a position to meet its repayment obligations. The firm's ability to do so is contingent, in part, on its survival prospects—its likelihood (as seen by the lender) of remaining in the marketplace. For this reason, firms that operate in risky environments, such as industries with more intense levels of competition, can be expected to face

[11] For both instrument- and source-based tests of differences, we compared small firms to those in the medium and large size ranges, and then large firms to those in the medium and small size ranges. All differences were statistically significant at the 5% level of confidence.

tighter lending conditions than firms in more stable sectors. While these expectations of success (and failure) can thus be expected to influence financing behaviour, access to loan capital is inexorably tied to the firm's ability to provide collateral against which the debt can be secured (Zider, 1998). Accordingly, more so than the risks of bankruptcy, it is the costs of bankruptcy (borne by prospective creditors) that matter. High-technology small firms that invest heavily in soft assets (research and new technology) at the expense of traditional hard assets (plants and equipment) have less to salvage in the event of failure, particularly if these investments are highly idiosyncratic. Similar patterns may be apparent across goods and services industries, if the new small firms in services devote less expenditure on hard collateral assets such as machinery and equipment.

Other studies have offset this explicit focus on risk evaluation in external capital markets by examining the *demand* for certain types of financing within the firm. Demand-based explanations accord neatly with Myers' (1984) "two ways of thinking about capital structure", namely the *static tradeoff* and *pecking order* frameworks. On the former, firms "substitute debt for equity, or equity for debt, until the value of the firm is maximized" (p. 577). Firms work towards target leverage ratios (an optimal balance of debt and equity) which vary across industries. One can expect to observe variation around the industry optimum due, first, to the effect of random shocks that move firms away from the optimum, and second, because of the adjustment costs associated with trading off debt against equity.

Pecking-order theories do not require any concept of a debt-to-equity equilibrium, only that firms exhibit an explicit preference ordering over the set of possible financing instruments. Following Modigliani and Miller (1958), businesses are expected to select financial instruments in ways that minimize costs, and meet their preferences for monitoring and control. Under the pecking-order hypothesis, internal sources are preferred to debt, and debt is preferred to (external) equity (Myers, 1984; Myers & Majluf, 1984; Hughes and Cosh, 1994).

Much of the existing literature presupposes a homogeneous firm population. Alternately, we could start with the proposition that firms differ substantially in terms of the strategies they pursue, and that this influences the type of asset base that they possess. Because of the tendency to match specific investments to particular sources of funds, firms that differ in terms of their strategies and activities are posited to possess concomitant differences in their financial structure. For example, innovative and non-innovative firms differ in terms of their investment strategies. Innovative firms are more likely to have soft assets. In turn, one would expect innovative firms to rely more extensively on equity sources (retained earnings and share capital) when financing their innovative activities, particularly if the conditions that are attached to debt place restrictions on these activities. A reliance on debt capital would therefore render the firm less likely to make the types of investment in risky assets (like knowledge capital) that produce innovations. Consequently, innovative firms should exhibit lower debt/equity ratios. In a related vein, firms with high debt-to-equity ratio should be less likely to innovate.

Our empirical analysis is guided predominately by a supply-driven framework—one that recognizes that firms are heterogeneous in their strategic decisions. Its purpose is to evaluate the extent to which industry-level and firm-specific characteristics serve as tangible market signals that encourage (or discourage) the development of certain financial structures. It should be

recognized, however, that the impact of supply- and demand-side factors is, in practice, difficult to disentangle. Small firms may exhibit low debt-to-asset ratios because they possess relatively more of one type of asset that is not well suited to debt financing, and are rationed in loan markets. These same small firms may also exhibit low debt-to-asset ratios because they prefer to finance their (risky) investments through internal equity. In our case, there is no clear distinction between "being chased out of the pool" and "not entering the water". Consequently, many explanations of differences in financial structure are "consistent with a chronic market failure constraining small firms to a sub-optimal position, or with a structure reflecting an optimal choice, or some combination of both" (Hughes, 1993, p. 217).

5. Variation in Capital Structure Across Industries and Firms

In this section, we investigate whether the capital structure of surviving entrants is related to different aspects of their operating environment (industry-level factors) or their performance history and strategic stance (firm-level factors). Both are potential determinants of financial structure. Creditors make funding decisions based on their expectations that prospective clients will be able to meet their repayment obligations. In making these decisions, creditors must evaluate the risk of lending to a firm, which will depend, first, on the likelihood of the firm failing, and second, on the collateral that can be recovered from the firm in the event of failure. Risk assessment may be done using either specific information on individual firms or by using more general information on a group, such as an industry, to which the firm belongs.

Industry membership is one basis for group risk evaluation since industry characteristics are readily observable and information relating to overall industry risk is relatively inexpensive to acquire. [12] The use of industry characteristics allows external creditors to focus on average firm profiles when evaluating risk—for example, by making broad distinctions between small firms in high-knowledge industries and those in low-knowledge industries, or between firms in highly-competitive industries and those in less-competitive industries. One disadvantage of industry profiles is that they may be less useful if firms within an industry vary widely in their operating characteristics. The alternative to industry or group evaluation is the use of firm-based characteristics directly. But these require creditors and investors to obtain very specific information on firms that is difficult to acquire and difficult to assess.

In this section, we examine whether industry-level factors or firm-specific characteristics, by themselves, are more useful predictors of financial structure. Certain characteristics of our sample suggest that individual characteristics may impart useful information to financial markets. All respondents to the *Survey of Operating and Financing Practices* have survived their first decade of operation and have therefore established themselves in the marketplace—producing an array of market signals on which to base outside evaluation and financing decisions.

[12] In a related vein, Zider (1998) emphasizes the importance of industry membership as a precondition for venture capital funding: "the myth is that venture capitalists invest in good people and good ideas. The reality is that they invest in good industries" (p. 133).

5.1 Industry-level Determinants

We begin by first considering three alternative factors that determine the amount of risk in an industry's environment: production activity, knowledge intensity, and competitive uncertainty.

5.1.1 Production Activity

Firms in goods-producing industries can be expected to possess more hard assets that offer secure collateral to lenders than their counterparts in services. Evidence of this exists from the *Survey of Operating and Financing Practices*—85% of respondents in goods-producing industries report making investments in plant and equipment (hard collateral assets), compared to only 69% of respondents in the service sector. New small firms in goods industries should thus make greater use of traditional debt financing. In the following analysis, we classify firms in our sample into binary groupings based on whether they operate in goods-producing or service-providing industries.

5.1.2 Knowledge Base

An industry's knowledge base—its relative emphasis on R&D and on skilled labour—is also posited to be correlated with financing patterns. New small firms that operate in industries that require substantial investments in knowledge (e.g., R&D or advanced technologies) may be perceived as risky—as investments in knowledge are costly to finance and have low collateral value. Firms in knowledge-based environments can be expected to rely more heavily on internal equity and less on debt.

The survey design stratified industries into high- and low-knowledge groupings using an index of knowledge intensity. For the goods sector, this index was based on five different criteria: a multi-factor productivity score, the proportion of workers with post-secondary education, the percentage of industry sales devoted to R&D, the percentage of firms in the industry using advanced technologies, and an innovation index. For services, three criteria were used: GDP per hour-worked, the proportion of workers with post-secondary education, and the industry average wage. Principal component analysis was then used to score industries, and classify them as high or low knowledge on the basis of whether they were above or below the median score.

5.1.3 Competitive Uncertainty

New small firms suffer from high rates of infant mortality. Mortality rates are related *inter alia* to differences in competition. Sectors with more intense levels of competition place higher survival demands on young firms (Baldwin et al., 2000). Differences in the competitive environment can thus be expected to influence the financial development of small firms if the amount of uncertainty in the marketplace is correlated with the failure rate. Firms in less stable or predictable market environments are posited to make less use of debt (as these firms are riskier), and rely more heavily on internal funds.

We develop a binary measure of market uncertainty based on scores from a series of questions that asked respondents to the survey to describe the intensity of competition in their industry. Firms rated the intensity of competition in eight areas (product obsolescence, production technology, resale values, consumer demand, competitor behaviour, consumer loyalty, supplier relations, and threat of entry). Firms assigned each factor a score ranging from 0 (not applicable) to 1 (low competition) through to 5 (high competition). Firms that scored 32 out of a possible 40 points on these eight questions were classified as operating in an uncertain environment.

5.2 Firm-specific Determinants

We now take up a number of firm-specific characteristics that may be correlated with capital structure.

5.2.1 Growth History

Firm-specific variation in post-entry performance may also engender differences in financial profiles. Firms with a proven track record may face fewer barriers to external capital, even when financing risky ventures. A firm's growth history may provide creditors with an additional performance signal—an observable indicator on which to base financing decisions. On the other hand, growth may have little value as a signal. Studies have shown that yearly growth rates are negatively correlated. Firms that grow more rapidly in one period grow less rapidly in the next (Baldwin, 1995). In order to examine the connection between financial structure, firms were classified into binary high- and low-growth clusters based on their compound sales growth from their second year of operation through to 1993.

5.2.2 Growth Expectations

Financing decisions may also be tied to a firm's growth expectations. Businesses that expect to grow rapidly are those who are less likely to suffer from the constraints that debt financing imposes, and less likely to worry about the bankruptcy risk associated with debt financing.

To test whether this was the case, we created a variable based on a question that asked respondents to project their expected revenue growth over a two-year period subsequent to the survey. A binary variable classified firms as having high-growth expectations if they anticipated annual revenue growth of 15% or more over this period.

5.2.3 Innovation Activity

We postulated earlier that an industry's relative emphasis on advanced knowledge is apt to influence the financial characteristics of member firms. Firms that operate in knowledge-intensive sectors are posited to make more use of internal funds. Innovation activities, evaluated

directly at the level of the firm, should yield similar effects.[13] Firms that invest heavily in knowledge creation may make less use of debt capital, irrespective of their industry status. We focus here on two aspects of innovative activity—R&D intensity and innovation status. R&D-intensive firms are identified as those that report R&D capabilities to be very important or crucial to a firm's overall success (a score of four or five on a five-point Likert scale)[14] or that report that their percentage of investment devoted to R&D was above the median of all entrants that report positive levels of R&D expenditure. As an alternative to this R&D-intensity measure (which measures inputs into the innovation process), we also evaluate the outcomes of innovation strategies directly. Innovative firms are identified as those that report the introduction of new (or substantially improved) products or processes in the two-year period prior to the survey.

5.2.4 Competencies and Abilities

Firm-specific competencies may also have some bearing on financial structure. A profile of Canadian bankrupts (Baldwin et al., 1997) links bankruptcy to key deficiencies in core functional areas—notably financing, marketing and management. Businesses that survive into adolescence often emerge with a broad array of functional competencies. At issue is whether firms that possess a strong competency base, or that report a considerable improvement in managing key business skills, are more likely to exhibit certain financial structures. It is worth stressing that we do not have strong priors as to the nature of these relationships, that is, on how the development of key competencies can be expected to influence financing patterns. If these internal competencies are difficult for lenders to evaluate, they will not be closely linked to financial structure.

The survey asked businesses to rate the importance of individual strategies in core functional areas (production, marketing, management, technology, human resources and financing). We utilize two binary measures of strategic intensity—the first related to financing, and the second a more general indicator of whether firms stress a range of different strategies simultaneously. In the former case, respondents that scored 12 or more out of a possible 15 points in the financing area were classified as intensive. Our second, more comprehensive, measure evaluated response patterns in the remaining functional areas, namely marketing, management, production, technology and human resources. We calculated an average score within each strategic area.[15] Firms were classified as intensive if they scored 80% or better in three of the five strategic areas.

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[13] This industry-to-firm distinction is not as tautological as it first appears. Baldwin and Gellatly (1999, 2001) have demonstrated that industry-level classifications can obscure the technological characteristics of certain populations, such as new small firms.

[14] A note on our method: We have relied on extreme scores (a score of four or five on a five-point scale) to separate firms that stress a particular strategy or competency area (here R&D) from other businesses. The advantage of extreme scores is that they identify all respondents that score a particular question higher than the median category (a score of three). Extreme scores thus provide a robust measure of the percentage of firms that deem a particular strategy or competency to be "very important" or "crucial" without worrying about distinctions beyond this point.

[15] The importance of all individual strategies was evaluated on a 5-point Likert scale. The average score for any functional area (e.g., marketing) is just total points divided by the number of strategies.

A second set of strategy variables focuses on whether the firm has made significant improvements in its business skills during its last five years of operation. Firms rated their improvements on a five-point scale. Once again, we set financing apart from all other business strategies. Binary variables were used to identify whether a respondent reports significant improvement (scores of 4 or 5), either in financing, or more generally across a range of areas (marketing, management, technology, production, human resources, innovation, customer and supplier relations). In the latter case, firms were classified as improving their overall business skills if they reported improvements in five of the eight areas.

5.3 Differences in Balance Sheets

In this section, we examine how the balance sheets of firms in our sample differ in accordance with the above industry and firm-level characteristics. We again focus first on their proportional use of different financial instruments and funding sources. Average capital structures are reported in Table 7.

Table 7. Average Capital Structure—Instruments and Sources (firm-weighted)

	Financial Instruments					**Financial Sources**			
	(RE)	(SC)	(SD)	(LD)	(OT)	(IN)	(FI)	(IS)	(OT)
All Firms	38.8	7.8	16.0	19.2	18.2	51.4	33.6	3.7	11.2
Industry environment:									
Goods industries	37.8	8.1	15.5	25.1	13.6*	47.2	35.0	3.6	14.2
Service industries	39.0	7.7	16.1	18.2	19.0*	52.1	33.4	3.8	10.7
High knowledge industries	48.6***	8.5	15.2	13.9**	13.8*	60.3***	26.5**	3.6	9.6
Low knowledge industries	32.3***	7.2	16.5	22.8**	21.2*	45.3***	38.5**	3.9	12.4
More market uncertainty	39.5	5.3	21.6	21.2	12.4*	51.0	32.4	7.5	9.1
Less market uncertainty	38.6	8.5	14.4	18.7	19.8*	51.5	34.0	2.7	11.9
Firm-specific factors:									
Faster-growing firms	38.3	6.5	18.5	20.3	16.4	52.3	35.0	2.6	10.1
Slower-growing firms	39.3	9.1	13.5	18.1	20.0	50.4	32.3	4.9	12.4
Higher growth expectations	22.6***	6.7	23.3	19.4	28.0	32.5***	45.6	5.0	16.9
Lower growth expectations	41.2***	7.9	14.9	19.2	16.7	54.2***	31.9	3.5	10.4
R&D-intensive firms	32.1	8.9	16.9	25.3	16.9	48.9	30.8	5.1	15.2
Non R&D-intensive firms	40.3	7.5	15.8	17.9	18.5	51.9	34.3	3.4	10.4
Innovator	41.5	10.3	16.2	18.7	13.3*	55.6	29.6	5.7	9.1
Non-innovator	38.1	7.0	15.9	19.4	19.6*	50.2	34.8	3.2	11.9
Stress financing strategies	31.4***	7.4	21.5***	22.4*	17.2	44.5***	41.3***	4.0	10.2
Other	45.6***	8.1	11.0***	16.3*	19.1	57.5***	26.8***	3.5	12.2
Stress multiple strategies	32.0	8.9	18.0	22.9	18.2	56.1	31.3	2.7	10.0
Other	40.0	7.6	15.7	18.6	18.2	50.6	34.0	3.9	11.5
Improved financing	36.7	7.0	16.2	21.0	19.0	47.5	35.0	4.9	12.5
Other	40.1	8.2	15.9	18.1	17.7	53.7	32.8	3.0	10.5
Improved overall abilities	37.0	7.2	17.9	22.1	15.8	49.2	35.1	4.3	11.4
Other	39.8	8.1	15.0	17.7	19.4	52.5	32.9	3.5	11.2

* Percentages may not sum to 100 due to rounding. *** Differences significant at 1%, **differences significant at 5%, * differences significant at 10%.

Knowledge intensity, evaluated at the industry level, is strongly correlated with financing patterns. Retained earnings (RE) are considerably more important in high-knowledge industries than low-knowledge industries, constituting 49% and 32% of financial instruments, respectively. Internal capital (IN) constitutes 60% and 45% of financial sources in high- and low-knowledge industries, respectively. Long-term debt (LD) receives greater weight in low-knowledge industries than in high-knowledge industries (23% of capital versus 14%), as do funds from financial institutions (FI) (39% of sources compared to 27%). This is consistent with the prevailing orthodoxy on high technology financing—firms that operate in knowledge sectors are far more dependent on reinvested profits and internal sources (due either to supply constraints or control aversion) than other businesses. It is interesting to note, however, that share capital and innovative sources (e.g., venture capital, joint ventures, and public markets) do not receive any more weight in high-knowledge industries.[16] Their representation in both sectors is minor.

Our other two measures of industry environment—market uncertainty and production activity—are not robust predictors of small-firm capital structure. Instrument and source shares are generally comparable across "more-uncertain" and "less uncertain" industries. Although not supported by our statistical tests, firms in the goods sector appear to place slightly more weight on long-term debt than their counterparts in services. In the main, however, differences in production activity are not associated with concomitant differences in financial structure.

Evidence that firm-specific factors are associated with differences in financial structure is mixed. Performance histories have little bearing on average financing profiles, as both high-growth and low-growth businesses make roughly the same proportionate use of many of the different financial instruments and funding sources. This result corroborates earlier research on growing Canadian SMEs (Baldwin et al., 1994) in which average debt and equity shares were remarkably similar across high- and low-growth firms.

However, when firms are separated on the basis of their growth expectations—that is, their expectations of future performance—differences in average capital structure emerge. Firms with high growth expectations make less use of retained earnings and internal sources. This provides some initial evidence that firms adopt outward-oriented financing strategies in order to fuel expansion.

Financing competencies are linked to debt-intensity. Firms that stress financing strategies obtain, on average, 41% of their funding from banks and trust companies, while these financial institutions account for only 27% of financing in other firms. Differences in short-term and long-term debt shares are also apparent.

[16] There are several potential explanations for this. First, our high- and low-knowledge groupings are extremely broad, and may obscure patterns of specialized financing if these are of a more industry-specific nature. Second, following Zider (1998), venture capital financing is targeted towards "growing" industries, many of which have traditionally been driven by advanced technologies. Our knowledge taxonomies do not incorporate a growth dimension.

Differences in average capital structure are less apparent when comparing firms that stress multiple competencies (i.e., production, marketing, management, human resources) to other businesses. In a similar vein, recent improvements in the development of core competencies—whether in terms of financing or multiple functional areas—are not correlated with financial structure.

Innovators and non-innovators, on balance, make similar use of retained earnings and debt. Similarly, R&D-intensity, when evaluated at the level of the firm, is not a strong predictor of capital structure. This bears stark contrast to the equity-intensive capital structures that emerge in knowledge-intensive industries. Industry- and firm-based measures of knowledge-intensity are thus not equivalent, and may yield very different portraits of small-firm financing in the high-technology sector. Only 46% of firms that are classified as R&D-intensive operate in high-knowledge industries (as defined by our specification).

Our bivariate profile of instrument- and source-use unearths a number of financing patterns within the small-firm sector. Industry-level measures of knowledge intensity appear to be strongly correlated with financial structure, as are firm-specific differences related to expected growth and the development of financing competencies. Other variables yield weaker results. Cross-industry differences in production activity and market uncertainty are not powerful predictors of capital structure. Innovative firms are not very different, in their use of debt and equity, than non-innovative firms.

5.4 Differences in Financial Specialization

As in Section 3, we again supplement our tabulations on the proportionate use of different instruments and sources with summary measures that examine the extent to which financial structures are specialized.

In Table 8, we present two measures—a rate of specialization[17] (similar to the aggregate specialization rates presented in Tables 3 and 5), and an estimate of numbers-equivalent entropy (comparable to those presented in Table 6). These capture the degree of "skewness" in the capital structure, the extent to which firms rely solely on single instruments and/or sources. The specialization rate is simply the percentage of firms that rely on a single instrument group (or source group) irrespective of which group is being utilized. The numbers-equivalent measure is again derived from an entropy measure of diversification, $Entropy = \sum_{i=1}^{N} s_i \log(1/s_i)$, where s_i is share of the instrument or source.

[17] The calculation of specialization rates based on financial instruments differs slightly from those presented earlier in Table 3. In this earlier table, we combined our two equity instruments—retained earnings and share capital—into a single instrument group. In Table 8, we separate these two into separate groups in accordance with the instrument taxonomy outlined in Table 1. Accordingly, firms that combine retained earnings and share capital are no longer treated as specialized (as was the case earlier in Table 3). This reduces our aggregate specialization rate from 49% (Table 3) to 45% (Table 8). Note that our method for calculating specialization rates based on source use is consistent between Tables 5 and 8.

Industry-level measures yield little statistical evidence of differences in financial specialization. That said, some qualitative impressions do emerge. Forty-six percent of service firms rely on a single instrument group, compared to 38% of firms in goods industries. Firms in high knowledge industries are more likely to rely on a single source of funds (56%) than their counterparts in low-knowledge industries (46%).

In contrast to earlier results on average financing profiles, basic differences in specialization patterns are apparent across many of the firm-specific characteristics examined herein. Growth history is illustrative. Faster-growing firms exhibit more diverse (less specialized) financial structures than their slower-growing counterparts. This is again consistent with earlier research by Baldwin et al. (1994) who found that faster-growing SMEs also develop more flexible financial structures.

Table 8. Additional Summary Measures—Instruments and Sources

	Financial Instruments		Financial Sources	
	Specialization Rate (%)	NE Entropy	Specialization Rate (%)	NE Entropy
All Firms	44.8 (3.3)	1.8 (0.1)	49.8 (3.2)	1.7 (0.1)
Industry environment:				
Goods industries	37.8	2.0*	42.2	1.9
Service industries	46.1	1.7*	51.2	1.7
High knowledge industries	46.3	1.7	55.6	1.6*
Low knowledge industries	43.9	1.9	45.9	1.8*
More market uncertainty	40.7	2.0	44.7	1.8
Less market uncertainty	46.0	1.7	51.2	1.7
Firm-specific factors:				
Faster-growing firms	38.6**	1.9**	45.5	1.8*
Slower-growing firms	51.0**	1.7**	54.1	1.6*
Higher growth expectations	57.0*	1.6	63.2**	1.6
Lower growth expectations	43.0*	1.8	47.8**	1.7
R&D-intensive firms	36.6	2.0	40.7	1.9
Non R&D-intensive firms	46.7	1.7	51.8	1.7
Innovator	34.7*	2.1***	40.7	2.0**
Non-innovator	47.8*	1.7***	52.3	1.6**
Stress financing strategies	36.5**	2.0***	44.4	1.9**
Other	52.4**	1.6***	54.6	1.6**
Stress multiple strategies	19.8***	2.2**	30.9***	2.1**
Other	49.1***	1.7**	53.0***	1.6**
Improved financing abilities	38.7	1.9	43.9	1.8
Other	48.6	1.7	53.3	1.7
Improved overall abilities	39.4	1.9	46.2	1.8
Other	47.7	1.7	51.7	1.7

*** Differences significant at 1%, ** differences significant at 5%, * differences significant at 10%.

The development of innovation competencies is also accompanied by greater financial flexibility. This is also consistent with earlier research on growing SMEs.[18] Firms that place greater emphasis on strategic competencies also develop less specialized, more flexible, financial structures. This is particular true of firms that emphasize many strategies simultaneously—only 20% of these firms rely on a single type of financial instrument, and only 31% on a single source of funds. Both more-innovative firms and those that possess an array of competencies are more likely to have a broad range of assets. That these firms are less specialized suggests that as the asset base of the firm diversifies, so too does its financial structure.

While informative, it is worth stressing that these distinctions between "specialized and flexible" financial structures need to be set in context. The entropy statistics reported above indicate that financial structures are, in the main, highly skewed towards a small number of instruments or sources. Even in cases where more flexible patterns are apparent (based on low rates of specialization), the entropy statistics in Table 8 indicated that average capital structures within this population are only about as diversified as one that has its instruments or sources equally distributed between two groups (that is, either two specific instruments or two specific sources).

5.5 Differences in Financing Strategies

The previous sections have shown that basic differences in the average financing profile (the proportionate use of instruments and sources) are not as apparent as are differences in financial specialization—the reliance of certain groups of firms on single financing instruments and funding sources. These results rely upon the use of relatively simple definitions of financial structure, (e.g.) the percentage of funds derived from retained earnings or long-term debt.

As a final exercise in this section, we use more complex weighted averages based on a number of characteristics—using principal component analysis to identify the dominant financing strategies within small firms. We do so in order to develop summary statistics that are richer than simple debt-to-asset ratios. A principal component is a weighted average of the original (individual) variables and therefore embodies the influence of multiple variables into the summary statistics that are created. Principal component analysis is a useful technique for highlighting strategic differences, as all individual components are, by design, statistically independent of one another. Each yields new insight into how firms combine instruments and sources within their capital mix. As the components are based on percentage distributions of instruments or sources (our set of individual variables that sum to 100), we have omitted our two residual groups: other instruments and other sources. Four important components were derived from our sample of roughly 2 800 firms. These represent mutually exclusive, or statistically independent, "financing archetypes" within the small firm population. We present these components in Table 9.

[18] Baldwin et al (1994) found that 38% of innovators relied on a single type of financing, compared to 52% of non-innovators.

Table 9. Significant Eigenvectors* from the Principal Components (firm-weighted)

Variables	1st Component	2nd Component	3rd Component	4th Component
Instruments:				
Retained earnings	-0.487	-0.310	-0.222	0.151
Share Capital	-0.093	0.587	0.441	-0.533
Short-term Debt	0.287	-0.435	0.588	0.111
Long-term Debt	0.335	0.286	-0.611	-0.083
Sources:				
Internal	-0.546	-0.020	0.009	-0.129
Financial Institutions	0.506	-0.230	-0.079	-0.221
Innovative Sources	0. 079	0.486	0.175	0.780

* Significant eigenvectors are those with eigenvalues greater than unity.

The first component represents the most important financing archetype in that it accounts for the largest percentage of the underlying variation in our sample (34%). The weights on this component attest to the importance of traditional debt and equity-based financing strategies—and, more notably, debt and equity tradeoffs—within the small firm population. Retained earnings and internal sources receive large negative scores, while short-term and long-term debt and funding from financial institutions receive high positive scores. This component represents firms that are either investing heavily in debt strategies with little emphasis on internal equity, or the reverse. That is, it represents the debt/equity tradeoff. Roughly 80% of surviving entrants in our weighted sample have long-term debt-to-equity ratios less than 0.3 (representing a maximum of 25% debt in their long-term structure) or greater than 3 (a minimum of 75% debt in their long-term capital structure). The concentration of firms at either end of the debt/equity spectrum is consistent with the entropy and specialization statistics presented earlier, all of which suggest that, on balance, small firms do not develop highly diversified financial structures that combine significant amounts of capital from different sources.

Component two represents small firms with a "high-technology profile"—businesses that trade off share capital and innovative sources against retained earnings. This component represents firms that make more use of share capital, long-term debt and funding from innovative sources, and less use of short-term debt and financing from traditional financial institutions. This component then represents the tradeoff between permanent capital derived from share capital and long-term debt versus that from retained earnings and short-term debt.

The third component represents firms that combine share capital with short-term debt, in place of long-term debt and retained earnings. The fourth component represents situations with less share capital but more innovative sources.

We now examine the extent to which the scores that firms receive on the first component—the component which represents the most important financing archetype—differs by certain industry and firm characteristics, specifically those related to knowledge creation. To do this, we compare the mean scores of the first component (representing the basic debt-to-equity tradeoff) across our three measures of innovativeness: R&D intensity, innovation status (both firm-specific characteristics) and knowledge base (an industry-level characteristic). All firms in our weighted sample have a score associated with the first component, ranging from a minimum value of -0.65 to a maximum value of 0.81. This score will vary systematically depending upon whether the

firm exhibits an equity-intensive[19] or a debt-intensive capital structure. As the firm utilizes progressively more retained earnings and internal funds, the probability of generating a high-component score decreases. Conversely, as the firm makes more use of long-term and short-term debt from financial institutions, the probability of generating a low score progressively declines.

Table 10. Average scores on the 1st principal components (firm-weighted).

	1st Component
R&D-intensive firms	0.04
Other firms	-0.01
Innovators	-0.04
Non-innovators	0.01
Firms in high-knowledge industries	-0.12**
Firms in low-knowledge industries	0.08**

*** Differences are significant at 1%, ** differences are significant at 5%, * differences are significant at 10%.

Our results mirror those on average capital structure presented in Table 2. Small firms in knowledge-intensive sectors are more equity-intensive than their counterparts in other industries. Strong equity or debt orientations are not apparent when examining the innovative stance of small firms directly. Innovators rely slightly more on equity than non-innovators; R&D-intensive firms place slightly more weight on debt than do other firms. Neither result, however, is statistically significant.

[19] Equity-intensive, in this context, refers strictly to retained earnings, and not to share capital.

6. Multivariate Analysis

6.1 The Estimation Framework

Investments in knowledge (e.g., R&D and technology acquisition) are strong predictors of high-performance in the SME population. In what follows, we use multivariate techniques to evaluate relationships between innovation and financial structure. The multivariate analysis is divided into two parts.

We begin by exploring relationships between R&D and financing using both single equation and simultaneous-equation frameworks. R&D is the classic example of a soft, knowledge asset—a physical investment in innovation that is costly to implement, difficult to evaluate, and whose productive outputs are far from certain (Arrow, 1962). Our simultaneous system is meant to evaluate relationships between innovation and financing in a more rigorous manner—by asking whether differences in knowledge-intensity lead to concomitant differences in capital structure, and conversely, if the reverse is true—whether differences in capital structure can be expected to influence the firm's investments in innovation. While both issues warrant investigation, the latter is, in our view, particularly important, as it speaks to the real consequences of different financing strategies.

Debates on R&D financing in Canada have focused on the need for equity capital. Baldwin and Johnson (1999) demonstrated that R&D is more likely to be financed out of equity capital than from debt. This corroborates earlier research on R&D financing. Bernstein (1986) found that additions to R&D capital were financed mainly by internal funds and share issues. Duncan (1999) argued that "a (knowledge-based) start-up in the R&D-based phase of its evolution must inevitably turn to equity investment".[20] Himmelberg and Peters (1994) report close relationships between changes in R&D investment and changes in cash flow over time.

The relationship between financial structure and R&D operates in both directions. On the one hand, the choice of an R&D-based innovation strategy will influence the nature of the financial strategy that is adopted. R&D investments have a risky outcome, and provide only soft collateral in the pre-patent stages. Thus R&D based strategies are likely to result in lower debt/asset ratios. On the other hand, we allow for the possibility that the financial structure is likely to affect the amount of R&D that can be undertaken. Respondents to Canadian innovation and technology surveys have consistently identified high financing costs as a major impediment to the development of innovations (Baldwin et al, 1998; Baldwin and Sabourin, 2002). Firms that are unable to develop the appropriate financing strategy are hypothesized to perform less R&D. If a firm raises debt capital, which normally constrains the types of activities that can be undertaken, it may be less inclined, and less able, to pursue R&D activity. We are, therefore, interested in examining whether firms that rely heavily on debt are less likely to perform R&D.

Our initial model then recognizes that there are two equations to be estimated. The first links R&D activity to the nature of the industry, certain firm characteristics and financial structure.

[20] Equity sources, in this context, refer to venture capital and angel financing.

The second links financial structure to R&D activity, along with other industry and firm characteristics. Our estimation framework thus takes the general form:

(2) R&D intensity = f (industry characteristics, firm characteristics, financial structure)
(3) Financial structure = g (industry characteristics, firm characteristics, R&D intensity)

where our measure of R&D-intensity is the share of investment expenditure allocated to research and development, and financial structure is the share of long-term debt in the firm's capital structure (both continuous variables bound by 0 and 1).

We estimate each equation separately via least squares, and then re-estimate using 2SLS assuming that both R&D and the financial structure are endogenous. We adopt a comparative approach herein, reporting both single-equation and simultaneous estimation methods. This confers analytical advantages. Different estimation methods allow us to place key individual results within a comparative framework, and thus provide us with a basic means for evaluating whether certain results are generally robust or highly idiosyncratic. What is more, comparisons across methods allow us to explore whether formally accounting for simultaneity brings about substantive changes in any of these observed relationships, in situations where such adjustments are warranted.

It should be noted that we treat all other firm-level characteristics as exogenous. We do so for several reasons. First, while changes in innovation may lead to concomitant changes in capital structure (and vice versa), it is not likely that variability in either will bring about a rapid shift in the firm's strategic orientation, or alter its long-term development of certain core competencies. Simply put, these firm-level characteristics in a cross section—unlike investments in innovation or debt-to-asset ratios—are less likely to be transitory. Thus, changes in endogenous variables that "feed back into" these strategy/competency characteristics are apt to have less of an effect. The likelihood of this simultaneity in a cross-sectional context is further reduced by the way in which these strategy/competency characteristics are measured. All are defined as binary (0,1) extreme scores—separating firms that deem an area (e.g., marketing) to be "very significant or crucial" (a value of 1, corresponding to scores of 4 or 5 on a Likert scale) from firms that attach less emphasis to the strategy or competency in question. While feedback from endogenous variables may bring about some reorganization of strategic goals and priorities (when ranked along a broad continuum), they are less likely to affect discrete measures like binary extreme scores.

We then extend our multivariate analysis by focusing not only on innovation inputs like R&D, but more explicitly on the outcomes of innovation strategies. We model the probability that a surviving entrant will introduce a new or improved product or process (focusing, in effect, on factors that determine the rate of innovation). We start with the supposition that R&D is an important, but not the only important determinant of a firm's innovation status, and ask whether financial structure has an additional impact on its likelihood of innovating—that is, additional to the effect that operates through the R&D variable. Elsewhere (Baldwin, 1996) we have shown that innovation is strongly correlated with success—here we ask whether certain financial profiles provide the foundations for this success.

6.2 Exploring Relationships Between R&D-intensity and Debt-intensity

6.2.1 Research and Development Expenditures

Following the model developed in Baldwin, Hanel and Sabourin (2001), R&D-intensity is posited to be related to both industry-level and firm-specific characteristics.

First, R&D-intensities are hypothesized to be higher in goods industries than in service industries because of inherent differences in the innovative environment. Robson, Townsend and Pavitt (1988) have shown that industries differ substantially in terms of their intensity of innovation. There is a group of innovative industries that produce more product innovation (capital goods and intermediate products), while other industries tend to ingest these innovations. In their classification scheme, goods industries fall into the former classification; service industries fall into the latter.

We also evaluate how the patterns of competition "condition" innovation inputs like R&D. Firms that operate in highly concentrated markets have been posited to be more likely to innovate. Monopoly power, it is claimed, makes it easier for firms to appropriate the returns from innovation and provides the incentive to invest in new products and processes. However, this view is far from universal. Others (Arrow, 1962) have argued that the gains at the margin from innovation are larger in a competitive industry than under monopoly conditions. Moreover, insulation from competitive pressure can breed bureaucratic inefficiency (Scherer, 1980).

Since the intrinsic concept that we want to evaluate is the intensity of competition, and concentration ratios are a poor proxy for this (Baldwin and Gorecki, 1994), we evaluate differences in competition by focusing on the number of competitors facing new small firms. Respondents to the survey were asked to identify the number of competitors that they face—a binary variable was then used to separate firms that face intense competition (20 or more competitors) from other businesses.

We also include an industry-level variable that captures differences in market lifecycle. Products go through distinct life-stages, and the nature of both market structure and the types of innovation that occur at each stage differ.[21] The earliest stage of the market is characterized by high volatility—when product standards are fluid and levels of entry and exit are high. It is here that product innovation is most intense. The second stage is characterized by rapid growth; here firms begin to concentrate more on process innovation, as price levels, rather than the uniqueness of product, play more of a role in developing a competitive advantage. The third stage involves more mature markets in which there is less entry, and considerable consolidation as firms focus on process innovation in order to reduce costs. The final stage is post maturity, where the primary product is becoming obsolete or is in decline. Because R&D is most closely associated with product innovation, we posit that R&D will be more intense in the earlier stages of the product life cycle. Four binary (0,1) variables are used to model these lifecycle effects,

[21] For a discussion of the relationship between innovation and life cycle, see Abernathy and Utterbach (1978), Rothwell and Zegveld (1982), Gort and Klepper (1982), and Klepper and Millar (1995).

corresponding to the different stages of market development (introductory, growth, maturity and post-maturity).

Our R&D equation also evaluates the impact of firm-specific covariates. These include firm size, growth history, export status, and the long-term debt to asset ratio (our measure of financial structure). In addition, we evaluate whether R&D intensity is related to a set of strategy and competency variables.

Size is included because of the Schumpeterian literature that focuses on the importance of size for R&D activities.[22] Reasons for this include scale advantages in large firms, a greater likelihood of engaging in risky projects, and economies of scope (Cohen, 1996). Larger firms have more access to financing, can spread the fixed costs of innovation over a larger volume of sales, and may benefit from economies of scope and complementarities between R&D and other manufacturing activities. However, counterarguments exist that suggest that as firms grow large, their expenditures on R&D become less efficient. Levin and Reiss (1984) review the empirical evidence and find that it is inconclusive. Economies of scale and scope may exist, but may be exhausted as firms grow.

In Canada, larger firms are more likely to perform R&D than smaller firms (Baldwin, 1997). But the evidence is less persuasive that larger firms spend a higher percentage of their total investment on R&D (Holbrook and Squires, 1996).

While size is often used as a proxy for scale effects, it also is a proxy for differences in the internal competencies of firms. Large firms do not differ from small firms in that they are simply scaled-up versions of the latter—a requirement if size captures only scale effects. Scale economies refer to differences that arise from an equal percentage increase in all factors. However, large firms use factors in very different proportions than small firms. Their capital/labour ratios are generally higher. The production characteristics of large and small firms are extremely different because of underlying differences in technology use (Baldwin and Sabourin, 1995). Large firms are not only more likely to adopt an advanced technology, but they also combine greater numbers of advanced technologies. The observed differences between large and small firms come from a host of factors that evolve as firms grow.

In many of our survey-based studies, we have emphasized the role that core business skills play in the development of innovation strategies. Over time, firms build up a set of competencies that are crucial for their overall growth and development. Those firms best able to develop certain key competencies relating to innovation might be expected to be in a better position to innovate. Baldwin and Johnson (1995), using data from a survey of small and medium-size businesses, found that more-innovative firms place more weight on marketing, finance, production, and human resource competencies than do less- innovative firms. For this reason, we make use of an expanded set of variables to evaluate cross-firm differences in strategic intensity. We include binary variables for each of the six competency areas examined herein—marketing, management, human resources, financing, technology and production—which take a value of 1 if the firm reports the area to be very important or crucial to its overall performance. We take a similar approach in evaluating how the long-run evolution of business competencies within the

[22] See also Cohen and Klepper (1996a, 1996b).

firm affects its propensity for innovation. Nine different (0,1,) binary variables are used to explore the impact of improvements in different areas: management, marketing, financing, human resources, production, technology, innovation, customer service and supplier relations. These variables take a value of 1 if the firm reports significant improvement in the respective business area (a score of 4 or 5 on a five-point scale).

We also include past growth as a predictor of R&D spending, because it is should be highly correlated with success in raising equity via internal cash flow. Faster-growing firms generate more cash flow and the latter is critical to financing soft investments like R&D.[23]

Finally, we include export orientation as a determinant of R&D spending. Baldwin, Hanel and Sabourin (2001) have shown that domestic firms that develop an export orientation are more likely to innovate and engage in R&D. To account for this, we include a binary variable that takes a value of 1 if the respondent reports export activity.

The regression coefficients are calculated against a reference group with the following characteristics: operates in the service sector; operates in low-knowledge industries; faces fewer competitors (less-intense competition); operates in a mature industry; exhibits a slower growth profile; does not export; has less than 10 employees; does not stress core business strategies; has not improved core business skills. Results for the OLS and 2SLS regression equations are reported in columns 1 and 3 in Table 11.[24]

There is evidence from both the OLS and 2SLS models that R&D intensity and debt intensity are negatively related—which conforms with our expectations, and runs counter to the bivariate tabulations presented in Section 5. Firms that have more debt in their capital structure devote a smaller percentage of total investment to R&D.[25]

Firms that operate in the goods sector are significantly more likely to be R&D-intensive. Competition and lifecycle effects that are significant are also apparent. Firms in more-competitive industries are less likely to develop R&D-intensive structures. R&D-intensity is higher among firms that operate in the introductory stage of an industry's growth cycle than among those that compete in mature industries.

Strategy and learning also play a role. Firms that have improved their innovation abilities are more likely to invest in R&D. The reverse is true of firms that stress production strategies.

In the OLS model, there is a strong positive relationship between export status and R&D intensity. However, this disappears in the simultaneous model, thereby suggesting that this result is sensitive to the interaction between endogenous variables.

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[23] At various stages of our regression analysis, we redefine our binary growth classifier to reflect differences in sample size. In all cases, weighted sample medians are used to identify high-growth and low-growth firms.

[24] Note that we limit our regression sample to include only firms with positive investment expenditure. This reduces our sample to 1,921 observations.

[25] This result also holds if we redefine our R&D measure as the probability of engaging in R&D.

Table 11. Single-equation and simultaneous-equation models (firm-weighted)

	Single-Equation		Simultaneous Equation	
	R&D Share (1)	**Debt Share (2)**	**R&D Share (3)**	**Debt Share (4)**
Industry-level variables:				
Goods	0.031**	0.035	0.050***	0.047
High knowledge	--	-0.075*	--	-0.064
High uncertainty	--	0.047	--	0.050
Many competitors	-0.039***	--	-0.045***	--
Introductory stage of market	0.188***	--	0.165**	--
Growth stage of market	-0.003	--	-0.004	--
Post maturity stage of market	0.001	--	-0.013	--
Firm-specific variables:				
Faster-growing sales history	0.023	0.041	0.042**	0.051
High expected sales growth	--	-0.005	--	0.028
Exporter	0.076***	--	0.033	--
Share of investment in R&D	--	-0.190**	--	-0.563*
10-24 employees	-0.011	-0.049	-0.022	-0.050
25+ employees	-0.010	-0.014	-0.010	-0.021
Stress financing strategies	0.020	0.026	0.020	0.029
Stress marketing strategies	-0.017	--	0.001	--
Stress management strategies	-0.003	--	0.002	--
Stress human resource strategies	0.026	--	0.032	--
Stress production strategies	-0.041***	--	-0.035**	--
Stress technology and R&D strategies	0.022	--	0.042	--
Overall strategic intensity	--	0.028	--	0.025
Improved financing abilities	-0.011	0.075	0.009	0.072
Improved marketing abilities	-0.016	--	-0.025	--
Improved management abilities	0.003	--	-0.002	--
Improved human resource abilities	0.017	--	0.000	--
Improved production abilities	-0.014	--	-0.001	--
Improved innovation abilities	0.060**	--	0.089***	--
Improved technological abilities	0.021	--	0.004	--
Improved customer service	-0.002	--	0.017	--
Improved supplier relations	-0.005	--	0.005	--
Improved overall abilities	--	0.051	--	0.071
Long-term debt to capital ratio	-0.041*	--	-0.360***	--
Constant:	0.018	0.140***	0.044	0.135
Summary Statistics:				
No. of observations	1921	1921	1921	1921
P-value	0.0000	0.0005	0.0000	0.0018
R^2	0.18	0.07	0.19	0.07

*** Significant at 1%, ** significant at 5%, * significant at 10%.

Our specification tests on the R&D equation indicate that 2SLS model is more appropriate. While the impact of export status is lost in simultaneous framework, a much stronger association between financial structure and R&D intensity becomes apparent. What is more, the 2SLS model also unearths a relationship between growth history and R&D intensity.

6.2.2 The Debt-to-asset Ratio

Our financial structure equation draws on the same set of covariates that were used in our bivariate tabulations in Section 5 (production activity, knowledge base, market uncertainty, growth history, growth expectations, investments in R&D, firm size, financing skills, improvements in financing, overall skills, and improvements in skill development). Our dependent variable is the continuous measure of debt-intensity—the share of long-term debt (secured and unsecured) in the capital structure. OLS and 2SLS debt-intensity equations are reported in columns 2 and 4 in Table 11.

Once more, we confirm a negative relationship between R&D-intensity and debt intensity. Firms that devote a larger portion of their investment expenditure to soft assets are less likely to exhibit debt-intensive capital structures. It is worth emphasizing that R&D-intensity is the only significant covariate common to both the LS and 2SLS debt-intensity equations. Sectoral patterns of knowledge intensity also influence debt intensity, albeit weakly, in the OLS model. This relationship is not apparent in the 2SLS model. Our endogeneity tests here provide less justification for moving to the 2SLS framework. All other covariates in the debt-intensity equation are insignificant in both models.

6.2.3 Sensitivity Analysis Using Different Proxies for Debt Intensity

To test how our results depend upon the definition of debt-intensity, we re-estimated the model using different measures of financial structure. First, we adopted a more-comprehensive debt-to-capital ratio (all debt, short and long) as the dependent variable in the financing equation and a covariate in the R&D equation. Second, we re-estimated our equations based on a more restricted measure of debt intensity—long-term debt as a share of long-term capital (debt and equity). We take up the discussion of each in turn.

We should stress at the onset that these alternative ratios are not conceptual substitutes for the long-term debt-to-asset ratio utilized herein. Our preference for a long-term debt-to-capital ratio is borne out of several considerations: first, long-term debt is difficult to acquire and often comes with formalized restrictions on usage (which often take the form of monitoring or performance criteria); second, long-term debt can provide a stable flow of "permanent" financing for ongoing R&D programs. Consequently, long-term debt ratios constitute a suitable measure for evaluating whether or not small firms face binding funding constraints—that is, whether external, long-term debt financing limits the ability of the firm to invest in soft (low collateral) knowledge assets like R&D. In this section, we adopt alternative measures of debt intensity in order to improve our understanding of what drives the relationship between R&D and capital structure. We should stress that, while both our comprehensive and restrictive measures are, at bottom, debt ratios, they may not speak, as directly, to the R&D financing issues being examined herein. For example, our comprehensive metric incorporates both short- and long-term debt into our proxy for capital structure. Short-term debt, however, may be a less suitable indicator of systematic financing constraints if firms are more reluctant to match temporary forms of capital to long-run investments in R&D. In a similar vein, our more restricted metric abstracts away from short-term capital altogether—by examining the level of long-term debt relative to long-term holdings (debt

and equity). While this measure gives some sense of the relative importance of long-term debt vis-à-vis equity (both potential sources of R&D financing), even firms with only a small share of long-term debt in their asset mix can register as debt-intensive, if their asset mix is comprised principally of short-term instruments.

Moreover, our preferred measure (long-term debt-to-assets) and the restrictive measure (long-term debt as a share of long-term debt and equity) are related. The ratio of long-term debt-to-total assets is just the product of "the ratio of long-term debt-to-long-term debt plus equity" and "the ratio of long-term debt plus equity-to-total assets." Finding that the first, but not the second, is related to R&D intensity tells us that it is the long-term debt-to-asset ratio that constrains the firm rather than the way it divides its total long-term capital between debt and equity—because taking on more debt relative to equity may not matter unless the sum of long-term debt and equity represents a large share of the firm's asset mix.

In our first exercise, we substituted a comprehensive debt ratio (the share of all debt, short and long, within the capital mix) for our original long term debt-to-capital ratio and re-estimated the regression results reported in Table 11. Here we found little evidence for moving to a simultaneous framework when estimating the R&D-intensity equation.

Many of the results for the single-equation R&D model are consistent with those reported in Table 11—except in one crucial respect. When a more comprehensive measure of debt intensity is used, we find no evidence that differences in financial structure influences investments in R&D.[26] Consequently, the strong negative relationship between R&D and capital structure, best observed earlier in the simultaneous version of the R&D equation, is no longer apparent.

Results for the debt-equation also change substantively when a more comprehensive measure of debt-intensity is used. As is true of our earlier results, there is no evidence for moving to a simultaneous framework in order to estimate the capital structure equation. However, the significant relationship between debt-intensity and R&D-intensity evident in the earlier single-equation debt model is no longer apparent. Consequently, when both long-term and short-term debt holdings are examined, firm-specific differences in R&D intensity are not correlated with differences in capital structure.

The above results suggest that relationships between R&D-intensity and debt-intensity are sensitive to the type of debt chosen. Total debt, expressed as a share of assets, is not a strong predictor of R&D-intensity. Long-term debt is.

In our second exercise, we replaced our more comprehensive debt metric with a more restrictive debt metric based strictly on long-term capital—the share of long-term capital (long-term debt and equity) accounted for by long-term debt. Once again, we re-estimated the results in Table 11. We should stress that this move to a more restricted debt metric effectively truncates the regression sample, as we now focus exclusively on the subset of firms that maintain some long-term capital (i.e., long-term debt or equity) in their asset mix.

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[26] Nor was any relationship between debt-intensity and R&D-intensity apparent in the simultaneous version the R&D equation.

Results for the single-equation R&D model (here the optimal specification) also differ from those reported earlier. Differences in capital structure do not influence the share of the investment mix that is devoted to R&D.[27] Evidence of some relationship between R&D-intensity and debt-intensity does emerge, however, when estimating the debt-equation based on this restricted (long-term) capital ratio.[28] Firms that exhibit high R&D-to-investment ratios are less likely to maintain debt-intensive capital structures, that is, they rely more on equity to make up the long-term portion of their capital structure. A strong negative relationship between knowledge intensity (evaluated at the sectoral level) and debt-intensity is again apparent. What is more, we also found weak evidence of relationships between firm growth and capital structure—firms with stronger growth histories and more robust growth expectations are more likely to develop debt-intensive long-term capital structures.

Our sensitivity tests reveal additional information about relationships between debt intensity and R&D intensity. First, it is long-term debt, not short-term debt, that is constraining. Second, it is not the division of permanent capital between debt and equity that matters; rather, it is the size of permanent capital relative to total assets that, in turn, influences the ratio long-term debt-to-total assets that is negatively associated with R&D performance.

6.3 Predicting the Likelihood of Innovation

We now turn to our innovation equation. Our objective here is to ascertain whether, after accounting for R&D-intensity and other innovation inputs, differences in financial structure have any impact of the firm's likelihood of introducing new products or processes. Innovation is operationalized as a binary variable that takes on a value of 1 if the firm reported that it introduced either a new or improved product or process. Innovation is modelled as a function of R&D-intensity and the same set of covariates that were included in the R&D–intensity equation that we estimated in Section 6.2.[29]

Financial structure is measured in two different ways. First, we utilize our basic measure of long-term debt intensity, bounded by 0 and 1, defined as the share of long-term (secured and unsecured) debt within the firm's capital mix (model A). Second, we utilize the values of the principal components that were derived in Section 5—which capture important (and statistically independent) financing strategies within the surviving entrant population (model B).

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[27] As was true when we used our more comprehensive metric (long-run and short-run debt), no apparent relationship between debt-intensity and R&D-intensity emerged in the simultaneous version of the R&D equation.

[28] Here Hausman tests provide some evidence for moving to a simultaneous framework.

[29] In the innovation models reported in Table 12, we use our original binary classification, first described in Section 5, to identify R&D-intensive firms. We did not use a continuous R&D-to-investment ratio to proxy R&D intensity (as we did in Table 11) because many firms in our sample did not report investment expenditures (and hence do not have well defined R&D-to-investment ratios). Our original binary R&D classification is defined for all units in our sample.

We estimated our model via a probit regression. The regression coefficients are calculated against a reference group with the following characteristics: operates in low-knowledge industries; faces fewer competitors (less-intense competition); operates in a mature industry; exhibits a slower growth profile; is not R&D-intensive; does not export; has less than 10 employees; does not stress core business strategies; has not improved core business skills.[30] Results are reported in Table 12.

Table 12. Single-equation innovation model (firm-weighted)

	Model A	Model B
	Pr (Innovating)	**Pr (Innovating)**
Industry-level variables:		
High knowledge	0.016	-0.027
Many competitors	0.315*	0.314*
Introductory stage of market	0.027	-0.071
Growth stage of market	0.333*	0.354*
Post maturity stage of market	0.129	0.113
Firm-specific variables:		
Faster-growing (based on sales history)	0.307	0.328*
R&D-intensive	0.352*	0.372*
Exporter	0.347	0.460*
10-24 employees	0.573***	0.478**
25+ employees	0.326	0.264
Stress financing strategies	-0.312**	-0.289*
Stress marketing strategies	0.211	0.250
Stress management strategies	-0.110	0.013
Stress human resource strategies	0.207	0.180
Stress production strategies	0.146	0.166
Stress technology and R&D strategies	0.871**	0.830**
Improved financing abilities	0.063	0.090
Improved marketing abilities	-0.311	-0.378**
Improved management abilities	-0.141	-0.202
Improved human resource abilities	0.291	0.299
Improved production abilities	0.198	0.093
Improved innovation abilities	0.460**	0.527**
Improved technological abilities	0.531***	0.655***
Improved customer service	0.182	0.201
Improved supplier relations	-0.404**	-0.431**
LT debt to capital ratio	-0.167	--
1st financing component	--	-0.268*
2nd financing component	--	0.294
3rd financing component	--	0.092
4th financing component	--	0.202
5th financing component	--	0.609
6th financing component	--	0.597
7th financing component	--	0.420
Constant:	-1.862	-1.971
Summary Statistics:		
No. of observations	2775	2738
P-value	0.0000	0.0000

*** Significant at 1%, ** significant at 5%, * significant at 10%.

[30] Note that the samples utilized in these probit regressions are larger than those used earlier to investigate relationships between R&D intensity and debt intensity. Our probit regression samples include both firms that report investment expenditure and other businesses.

Firms that operate in more-competitive environments are more likely to introduce innovations than those in less-competitive environments. This contrasts with the negative relationship between R&D-intensity and competition that was apparent in our earlier regressions. Some relationship between innovation and the lifecycle is again apparent. Firms in the growth stage of the product lifecycle are more likely to innovate than their counterparts in mature industries.

R&D-intensive firms and those that stress technology and R&D strategies are more likely to innovate. In one of our models, growth history is weakly significant. This relationship becomes more robust when the sample is restricted to firms with "long-term" capital structures.[31] Size effects are apparent, though nonmonotonic. Firms in the medium-size range are more likely to innovate than small firms.

Our base measure of financial structure (the long-term debt-to-capital ratio in model A) is not significant. We again evaluated two alternative proxies for financial structure—first, based on a more inclusive debt measure (the share of all debt, long- and short-term, within the capital structure), and second, based on a more restricted debt-measure (the share of long-term debt within the firm's long-term capital structure). These yielded the same result—debt-intensity is not correlated with innovation status.

In the version of the model that uses the principal components to represent "strategic archetypes", (model B) we found a weakly significant relationship between the first component (which describes the debt and equity tradeoff) and the probability of innovation. Firms that exhibited debt-intensive structures are less likely to innovate.

We also found some evidence of endogeneity from the Hausman tests on the principal components, and thus extended the above exercise by estimating a model in which a set of instruments were used in place of the individual components. We created these instruments by regressing each component on its rank and all other RHS variables in the innovation equation, and then using the subsequent predicted values in lieu of the component scores. On balance, this again yielded a similar set of results to those estimated in the original model.

[31] These are firms with some long-term capital (retained earnings, share capital or long-term debt) in their financial structure.

7. Conclusion

Small-firm investment activity has been widely described as being constrained by operations of both debt and equity markets. Debt markets are loath to lend to young firms that do not yet have a track record. Equity markets are said to do the same. Based on these factors, small firms are often seen as being constrained to some suboptimal financing position.

Small firms, when evaluated against large companies, are often seen to possess a *deficient* financial structure[32] (much in the same way they are often seen as less innovative, on the grounds that they perform less continuous R&D). In our view, this is not so much a matter of deficiency as one of difference. New small firms face a more uncertain competitive environment than other businesses—evidenced by more variable rates of return and higher rates of infant mortality. Firms that operate in riskier environments can, in turn, expect to face higher costs of external finance, leading many to rely more extensively on internal sources of equity. As to whether these equity-intensive structures are suboptimal depends, not on the existence of funding gaps *per se*, but on whether more restricted access to debt or external sources of equity serves to hamper the performance of small firms, restricting their ability to grow and innovate.

This problem is seen as particularly severe when it comes to investments in innovation, which have been described as:

> "distinct in certain crucial respects from the financing of other forms of business investment. Business investments in land, building and equipment produce tangible assets, intended to yield a quantifiable return to the investor over an agreed period. Investment to innovation is quite different; it produces the intangible of new knowledge that can, as a marketed product, yield great returns. However, the timing of these returns is more difficult to forecast and their probability less clear" (National Advisory Board on Science and Technology, 1991:1).

What is the evidence on small-firm problems? In his study of high technology small firms in Britain, Moore (1994) found that constraints on early capitalization (i.e., restricted access to debt or external sources of equity) had a debilitating effect on the development of knowledge-intensive firms. Caldwell, Sawchuk, and Wilson (1994) have shown that small firms in Canada face a higher cost of capital than their counterparts in other economies, due primarily to relatively high costs of equity in Canada. In an earlier survey of financing patterns in Canadian businesses, Peterson (1996) found that small firms place much greater emphasis on traditional financial sources, such as banks and trust companies, and comparatively little emphasis, in the main, on raising funds via external equity sources. This is consistent both with the argument that equity costs in Canada are relatively high and with recent work on Canadian firms by Feeney, Haines and Riding (1999) who observed that small businesses often prefer to remain tightly held, and steer away from equity strategies due to their implications for ownership and control.

[32] For examples, see D'Amboise (1991) and Gagnon and Papillon (1984).

We have addressed this issue herein by examining relationships between financial structure and innovation. If debt-intensive firms are more likely than equity-intensive firms to introduce new goods and services, then issues of funding gaps come to the fore. If, however, firms prefer to support investments in knowledge with equity (as may be the case if equity financing affords firms greater flexibility when undertaking these investments), then the economic consequences of funding gaps in traditional debt markets may be less severe.

It is not our objective to demonstrate that small firms in high-knowledge industries are debt-constrained or equity-constrained, though we can evaluate whether, on average, they make greater use of debt than firms in low-knowledge industries. Our focus, then, is on identifying the determinants of capital structure, that is, on possible explanations of differences, and their impact on knowledge creation.

To do so, we have focused on small-firm populations, comprising entrants in many different industries, and not simply on firms that operate in highly-visible, high-technology clusters or networks. This, in turn, has direct implications for the types of financing arrangements that we can expect to observe. Venture capital funding is a case in point; venture capital financing accounts, on average, for less than 1% of all funding in the firms being examined here. Retained earnings and bank loans constitute the major sources of funding within this sector. External sources of equity, even among the elite small firms studied here, are not significant sources of funding.

Our results confirm that it is indeed the equity side of the balance sheet that constrains innovation in small firms. Equity is more important than debt in industries that are both more risky generally and in knowledge industries where substantial investments in R&D are being made. Firms that devote a larger percentage of their investment to R&D are even more likely to have more equity. Equally important, there is evidence of a reverse causality from financial structure to activity. Holding industry characteristics constant, firms that take on relatively more long-term debt are less likely to engage in innovative activity.

It should be noted that none of this implies that firms are necessarily constrained by capital markets. Throughout this study, we have stressed that firms are heterogeneous entities. Although different firms within an industry face the same opportunity set and the same set of factor prices, they differ in terms of the resulting strategies that they choose to pursue. This study has found that some choose to develop the financial competencies that allow them to raise funds in debt markets. But this group is less likely, not more likely to innovate. Firms that raise more of their funds through equity markets, on the other hand, maintain the type of flexibility that is needed in order to pursue research and innovation opportunities. In this sense, financial strategies become part of the innovation strategy of the firm.

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